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Are all Equations of State in Neutron Stars born alike?

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We have recently provided the generic band of equations of state for matter at attainable densities in zero- and finite-temperature neutron stars restricted only by hadronic physics and fundamental principles, which are crucial for testing General Relativity and theories beyond it. We also characterise any first-order phase transitions therein by the specific latent heat, which we have systematically explored with these EoS for different interpolations. In addition, we used these GR-independent equations of state to constrain the quadratic Palatini gravity f($\mathcal{R}$).

In this work, we incorporate an EoS based on no potential, rather directly from nucleon scattering data [1] for pure neutron matter (PNM) at zero temperature and very low densities by interpolation up to known higher-density physics, applying causality, monotonicity and thermal consistency, in two steps. We use a first interpolation between the uncertainty band obtained for PNM and the saturation density, constrained by nuclear experiments. Then, we use a second interpolation between this band and the high-density perturbative QCD regime so we cover number densities in the range $10^{-8} \leq n < 7$ fm^{-3}.

References
[1] J. M. Alarcón and J. A. Oller. Nuclear matter from the ladder resummation in terms of the experimental nucleon-nucleon scattering amplitudes. Phys. Rev. C, 107(4):044319,2023.

session

H. Equation of State and Neutron Stars

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